TRENCHLESS TECHNOLOGY

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Trenchless Technology

- Overview
- Operation
- 0 – The Soil
- 1 - Description
- 2 - Services
- 3 - Design Considerations
- 4 – Engineering Considerations
The Soils Report / Geotechnical Report

- Critical to the success of trenchless projects
- Key to the selection of the trenchless method
- Planning here – saves money later on
- Ground conditions can limit any construction work
- Take time with your Trenchless contractor to understand the implications
- Know your water table!

The Soils Report cont’d

Utilized as a guide and is used in conjunction with field experience and understanding of the complete geo-technical report
The Total Solution

Soils Report
Technology
Understanding
Trenchless Contractor

Trenchless Methodologies

- New Pipe Placement
  - Replacement / Rehab
- Main types of Trenchless Technologies (Ontario)
  - Augering (Jack & Bore)
  - Tunneling / Pipe Jacking
  - Pipe Ramming
  - Directional Drilling
  - HDD Assist
Directional Drilling

- Surface launched, electronically guided, steerable (depth-roll-pitch), bore

- 20mm water services to 1200mm water transmission pipeline, tremendous success with gravity sewers and other grade specific projects

- Pilot bore created along predetermined bore path with 1.5m to 6m drill rods (drill string)

- A reamer is used to enlarge the bore path

- Once the hole is enlarged (25% to 50% larger than product pipe) the product pipe is pulled into the bore hole
### Directional Drilling (Design Considerations)

- **Project**
  - Drainage, Sewer, Water main, Horizontal Wells, Electrical, anything short of large diameter steel casing
- **Ground**
  - Variable, not suited for cobble
- **Area – Location**
  - Require minimal space for set up and limited excavation
- **City, Region Acceptance**
  - Popular solution
- **Environmental Consideration**
  - Great for preserving environment, streams, trees, roads, small setup footprint

### Directional Drilling (Design Cont’d)

**Application Requires**

- **Quick Installation**
- Water crossing
- Minimal Start and receipt pits (depends on application)
- Long distances - 10m to over 400m
- Very little disruption to surrounding area, environmentally sound
- Cost effective pipe laying technique
Walk-over System
- Most cost effective
- Updates quickly
- May experience surface interference

Wire-line Systems
- Slower to bore - Insertion of wire-line and survey plot
- More expensive to operate
- Used for extreme depths or areas where walkover survey is restricted (water body, steep grade, building)
Directional Drilling
Mud Mixing - Back Reaming

- Reaming of hole to proper size
  - Mud enables the hole to stabilize and remain open
- Amount needed
  - \( \frac{(\text{Hole Diameter})^2}{25} = \text{Volume of Mud (GPF)} \)
  - Multiple depending on soil type

- “Inadvertent Returns” or “Frac-out’s”
- Plan required for mud clean up and disposal

Directional Drilling
Mud Mixing

- Essential component of a successful bore
- Bentonite used in sand
- Polymer used in clay
- Combination of bentonite and polymer used in glacial till

- Poly Swell
- Magma Fiber
Directional Drilling (Bentonite)

Marketed as a ‘healing clay’
People pay to drink this stuff…

Directional Drilling Simplified
Directional Drilling (Engineering Consideration)

- Soil – Geo-Technical Report
- Timing
- Access & ROW
- Staging
- Inspection

Directional Drilling (Environmental Consideration)

- Responsible Contracting
- Environmental Mitigation
- Frac Mitigation - Wells
- Mud Management Plan, Poly Swell, Viscosity
- Silt Curtains
- Coir Logs
- Sand / Pea Gravel Bags
- Silt Fence
- Depot Supplies
- Written Program
- Environmental Policy
- Environmental Consultant
Pipe Ramming

- Pneumatic hammer used to ‘ram’ steel casing into ground - sizes from 500mm to 2100mm diameter
- Casing is ‘rammed’ in 6m to 12m (<) segments

After each casing is rammed, another segment is welded or mechanically fitted together

Once ramming is complete the soil inside is removed by augers

Product pipe is inserted / ‘threaded’

Grouting, typically occurs once rest of pipeline has been installed
Pipe Ramming (Design Considerations)

- **Project**
  - Drainage, Sewer, Watermain,

- **Ground**
  - Typically utilized in more challenging soil conditions, hard ground, cobble

- **Area – Location**
  - Require space for set up
  - Loud percussion hammer

- **City, Region Acceptance**
  - Making In-roads
  - CNR and CPR ‘encourage’ methodology

- **Environmental Consideration**
  - Great for preserving environment, streams, trees, roads, railways

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Pipe Ramming (Design Cont’d)

Application Requires

- Compatibility w/ cobbled soil, hard ground, wet raveling ground
- Consideration of high water table conditions, no bore path de-watering
- Handle rocks to the size of the ID of the casing
- No void creation caused by removal of bore path boulders
- ‘burst’ boulders in path
Pipe Ramming (Engineering Consideration)

- Soil – Geo-Technical Report
- Timing
- Access & ROW
- Staging
- Inspection

Augering - Jack & Bore

- Mechanical removal of soil via cutting head/augers to create a horizontal hole
- Soil (Spoil) is removed via augers
- Simultaneously jack steel casing as soil is removed
- Specific grades can be achieved for required applications
Augering - Jack & Bore

- Casing augered in 3m to 6m lengths (250mm – 1500mm diameter)
- Completion -- augers removed, product pipe is braced, inserted (threading)
- Grouting, typically occurs once rest of pipeline has been installed
- Proven method of pipe installation with well defined standards

Augering - Jack & Bore (Design Consideration)

- Project
  - Sewer, Water main, Grade sensitivity
- Ground
  - Soils report (test bore/hole)
    - Wide range of soil conditions, varying cutting heads to address needs.
    - Distances of 3m - 100m
- Area – Location
  - Ideal location, adaptability
  - Space to set up shaft and store material
- City, Region Acceptance
  - Well known & accepted technology
- Environmental Consideration
  - Great for preserving environment, streams, trees, Railways and of course roads
Trenchless Since 1947

Augering - Footprint

Augering – Grade Management

Steering Mechanism

Steering Head Assembly

For long distance bores that require specific grade – a steering head can be utilized to effectively maintain or correct grade variances.

Electronics utilized to verify and assist in grade correction

Keeping grade and line on long distance ‘shots’
Augering – Grade Management

Augering - Jack & Bore (Design Cont’d)

Application Requires
- Tried and True
- Defined Stds.
- Grade Sensitivity
- Environmental preservation
- Acceptance
Augering - Jack & Bore (Engineering Consideration)

- Soil – Geo-Technical Report
- Timing
- Access & ROW
- Staging
- Inspection

Augering - SBU

- Control Line and Grade
- Big Tunnel Tech
- Small Tunnel Project
- Grade Sensitivity
- Highly Successful
- Rapid
Augering - SBU

Trenchless Since 1947

Augering - SBU
Tunneling / Pipe Jacking

- Directly installing pipes behind a Shield Machine by hydraulic jacking
- Excavation can be performed manually or mechanically

- Usually crew req’d inside pipe to perform excavation/spoil removal process - manual
- Mechanical units may require crews inside to monitor soil cutting and grade variances
Tunneling / Pipe Jacking (Design Consideration)

- **Project**
  - Trunk Sewer, Trunk Water, Extreme Grade Sensitivity, constrained work area, Drainage, Walkway, Distance 60m+

- **Ground**
  - Wide range of soil conditions, typically utilized in challenging soil conditions

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Tunneling / Pipe Jacking (Design Cont’d)

- **Area – Location**
  - Shield method requires comparable less space
  - Require space for jacking equipment

- **City, Region Acceptance**
  - Well known, widely accepted

- **Environmental Consideration**
  - Great for preserving environment, rivers, streams, trees, railways, roads
Trenchless Since 1947

Tunneling / Pipe Jacking (Design Cont’d)

Application Requires

- Quick Set up (Manual)
- Accuracy - grade is critical
- Versatility due to various ground conditions
- Cost efficiency with large diameter pipe
- Well known solution - oldest technology

Tunneling / Pipe Jacking (Mechanical)

Typical Set Up for a Tunnel Boring Machine’ (TBM)
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**Tunneling / Pipe Jacking**  (Mechanical)

The 'Inner Works' of a Tunnel Boring Machine' (TBM)

![Image of Tunnel Boring Machine Interior](image1.jpg)

![Image of Tunnel Boring Machine Interior](image2.jpg)
Tunneling / Pipe Jacking
(Engineering Consideration)

- Soil – Geo-Technical Report
- Timing
- Access & ROW
- Staging
- Inspection

HDD Assist

- Pneumatic hammer used to ‘re-start’ stalled installations
- Hammer / transition piece attached to end/top of carrier/product pipe
- Hammer assists in pullback
HDD Assist (Considerations)

- Projects that can benefit -
  - Drainage, Sewer, Water main, Gas Main, Rigid Installation
- Ground
  - Assist application – ground is less of a consideration
- Area – Location
  - Require space for set up
  - Loud percussion hammer
- City, Region Acceptance
  - Solution to stalled installation
- Environmental Consideration
  - Continue to preserve environment by assisting initial trenchless method

HDD Assist (Considerations Cont’d)

Job Requires
- Compatibility w/ cobbled soil, hard ground, wet raveling ground
- Consideration of high water table conditions, no bore path de-watering
HDD Assist (Engineering Consideration)

- Soil – Geo-Technical Report
- Timing
- Access & ROW
- Staging
- Inspection